

CircuitX in Action: Formula E Puts 5G to the Test at 250 km/h

CircuitX partners harness 5G connectivity to enrich fans' experience of motorsports

- The GSMA's CircuitX initiative is exploring how 5G can cost-effectively meet motorsports' demanding connectivity requirements.
- Formula E is testing the transmission of live HD video from race cars over public 5G networks
- Connecting race cars to the public 5G network in Sanya, China, proved straightforward and the vehicles were able to transmit high-quality video at speeds of 250 km/h.
- The Formula E team plans to run further tests of 5G across different circuits within cities and on dedicated tracks, on multiple vehicles simultaneously.
- The high-speed tests point to how 5G standalone networks could enhance live events, improve transport and support remote-controlled vehicles

CIRCUITX
TRANSFORMING THE CIRCUIT EXPERIENCE WITH CONNECTIVITY

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All kind of vehicles now have wireless connectivity. Race cars are no exception. They now routinely stream video footage from the cockpit, which can then be relayed to television viewers, as well as to team members in the pits.

Today, motorsports generally rely on proprietary wireless networks using dedicated spectrum temporarily allocated by the local authorities for use during the event. But 5G mobile networks could provide much of the connectivity required, reducing costs for race organisers.

Launched at MWC Barcelona in 2025, the GSMA's CircuitX initiative is exploring this opportunity. A three-year partnership between the GSMA Foundry, Mobile World Capital, Barcelona, and the Circuit de Barcelona Catalunya, CircuitX is helping Formula E and other motorsports harness mobile connectivity to enhance the live experience of fans at the event and those watching remotely, while also collecting important telemetry data from race cars.

At MWC Barcelona 2026, CircuitX hosted a series of demos and tests at the Circuit de Barcelona Catalunya. For example, Al Kamel Systems, Domo Broadcast, Ericsson and Semtech worked together to enable a live demonstration of vehicle-to-track communication via 5G. A connected camera used a network slice on Telefonica's 5G network to transmit live video content from a Formula E car back to the CircuitX showcase lounge, a first for Formula E using advanced cellular connectivity.

The objective was to see how "off-the-shelf 5G" would perform, Eric Ernst, Executive Technology Advisor / CTO, Al Kamel Systems, told a panel discussion at MWC Barcelona, and understand "what we can we take from all these partners that the GSMA has opened the door for us to communicate with." Having worked at Formula E in the past, he noted that harnessing public 5G networks could make it financially viable for even small events to make extensive use of wireless connectivity to engage fans.

Formula E has since run further 5G trials: In June 2026, it worked with the GSMA to perform tests ahead of a race in Sanya, a city on Hainan Island in southern China. The 5G network successfully transmitted live video from race cars traveling around the city circuit at speeds of up to 250 km/h.





Deploying dedicated networks is expensive and time-consuming

Broadcasting the race live, and providing an immersive and dynamic view of the racing action for fan engagement is fundamental for Formula E. With a global cumulative TV audience of 561 million in Season 11 (2024-25), that's a race average cumulative audience of 33 million fans tuning in per race.

If motorsports could use existing cellular networks to stream high definition (HD) video, that would save a lot of time and money. Before each Formula E race, a team of six engineers spends up to a week installing dedicated wireless antennas and fibre cables around the race circuit.

"We travel around the world with a lot of kit," says Hamish Harris, Broadcast & Media Technology Director at Formula E. "There's a whole ground-based network that has to be put in every racetrack, which takes three or four days, depending on the size of the track. In Monaco, for instance, we run 12 antenna sites that have got two antennas each, and we run a lot of fibre around the Principality to connect all those receive sites."

The Formula E team also has to book the necessary wireless spectrum in each of the 12 countries the race visits. There needs to be sufficient capacity to enable each of the 22 cars in a race to upload video at 14 Mbps simultaneously. Ideally, the spectrum will be completely vacant, but that isn't always the case, meaning extensive testing is required. Beyond the actual races, there are also occasions when a Formula E team needs to mount wireless cameras on cars for testing purposes or for a public demonstration.



As they become more performant and more capable, public 5G networks could help cost-effectively meet the growing demand for wireless connectivity in motorsports and other popular events.

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Hamish Harris - Broadcast & Media Technology Director at Formula E

Testing 5G across the city circuit in Sanya

For the trial in Sanya in June, working with GSMA CircuitX and China Mobile teams, Hamish Harris and his colleagues custom engineered and installed a 5G broadcast kit into the Formula E car. Consisting of standalone power supply, antenna and 5G enabled modem utilising China Mobile SIM cards. As a result, they could connect to the operator's 5G standalone network, which is optimised to serve tourists visiting Sanya. With a cloud-native core, 5G standalone networks are more versatile and programmable than their predecessors.

Building on the initial test at the Circuit de Barcelona Catalunya, the Formula E team wanted to see if the public network in Sanya could sustain a high bit rate even as the car was travelling at 250 km/h around the 3km city circuit, as well as reduce the latency of the feed to be suitable for live broadcast. The entire circuit is covered by a single cell of China Mobile's network, so handovers between base stations weren't necessary.

A city circuit, such as that in Sanya, presents different connectivity challenges to those associated with a dedicated racetrack. "We're finding the difference between the street circuit we had in Sanya and a permanent racetrack like you have in Barcelona and Shanghai is that when you put a permanent racetrack in, they optimise the networks for the stands," notes Hamish Harris. "You know exactly where the public's going to be, so you optimise the antennas for the grandstands."

The Formula E team had to cancel equivalent tests at the Shanghai circuit, after bad weather reduced the time available on the dedicated track there. "We were really looking forward to being able to do a direct comparison between what it looks like when the networks are optimised for people walking around the streets on a street circuit versus what happens if you're at a permanent racetrack where the networks are optimised for the stands," explains Hamish Harris. "We had predicted beforehand that we were not going to have as much success in Shanghai as we did in the Sanya."

The tests in Sanya took place as the public continued to use China Mobile's 5G network as normal. As the idea was to test real-world usage of public 5G, the operator didn't change any of the network parameters for the test and didn't provide Formula-E with a dedicated network slice.

View the test video footage from Sanya



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Straightforward set up, high bit rate

For the Formula E team, connecting a car to the public 5G network proved to be straightforward. "The network was really good in terms of literally plugging the SIM card in, building the streams to the decoder, and being able to get something working," says Hamish Harris.

Although there was one black spot on the race circuit due to known local restrictions, the video stream from the vehicle ran smoothly, even when the car was driving at high speeds. "We had a comparable bit rate to what we usually run on our dedicated RF (radio frequency) network," says Hamish Harris. "And the pictures were really good. I couldn't tell the difference between the 5G pictures and the RF pictures, aside from a little bit of breakup that we had on the track. So, it was a really positive test."

The Formula E team was also impressed with the end-to-end latency of the video feed from the car. "It was a couple of seconds, which is pretty good. It was far better than it was in Barcelona," says Hamish Harris, explaining that in Sanya the bit stream from the car was transmitted directly to a decoder, rather than travelling via a cloud system, as was the case in Barcelona.

When broadcasting live video during an actual race, the Formula E team needs the video feed from the car to be synchronised with the feeds from the other cameras around the circuit. That's because the producer will typically cut from a circuit camera to an in-vehicle camera and back again.

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CircuitX showcases 5G's potential in motorsports

To raise awareness of the potential of 5G networks to live stream videos from vehicles, Formula E and the CircuitX initiative also showcased 5G-connected cars at MWC Shanghai 2026. Onboard cameras used the 5G network to stream live footage to displays mounted at the event.

Earlier in the year, in the exhibition halls of MWC Barcelona, Formula E demonstrated how live telemetry data can be used to achieve net zero targets, while its CircuitX partners showcased other systems and solutions that can be used to enrich motorsports. For example, Al Kamel Systems, supported by Semtech & Domo Broadcast Systems, demonstrated ultra-low latency connectivity to instantly detect incidents and support dynamic race strategies, and NTT DATA presented its AI-powered ops, safety monitoring and intelligent fan insights. BCN Drone Center highlighted how connected drones can be employed for crowd monitoring, emergency response and smart venue security, while Into Reality presented immersive AR/VR systems that can blend physical and digital images to enhance the fan experience.

The CircuitX Demo Zone at MWC Barcelona also put a spotlight on Ericsson Enterprise Wireless Solutions' private 5G networks for secure telemetry, real-time video and low-latency event connectivity and MatSing's high-capacity RF lens antennas for robust venue wireless coverage and data flow. Reflecting on the value of participating in CircuitX during a panel session at MWC Barcelona, Leo Matytsine, Executive VP of MatSing, explained that his company benefits from seeing how different technologies can work together. "Not one technology can solve everything," he noted. "To see how everybody can come together and provide different solutions, look at different venues and solve different problems, was a very useful experience for us."

Further tests on the horizon

Looking forward, the Formula E team plans to run further tests of 5G across different circuits within cities and on dedicated tracks. In particular, there is a need to run tests in multiple regions and countries to gain a greater understanding of whether 5G networks will perform consistently in the same manner across the entire race calendar. As well as testing high-speed handovers from one base station to another, Hamish Harris would like to evaluate the relay of telemetry data from the vehicle, alongside video streams, via a 5G network.

Alongside testing in different locations, there is a need to test 5G connectivity with multiple connected vehicles on track simultaneously – in the approaching Formula E Gen 4 Era (2026/27) this could mean ~25 vehicles running on the circuit when you factor in 22 race cars and the required safety vehicles.

If these further tests prove to be successful, Formula E is likely to use the public 5G networks to supplement its dedicated wireless network, particularly for demonstrations and practice rounds, outside the actual race itself.

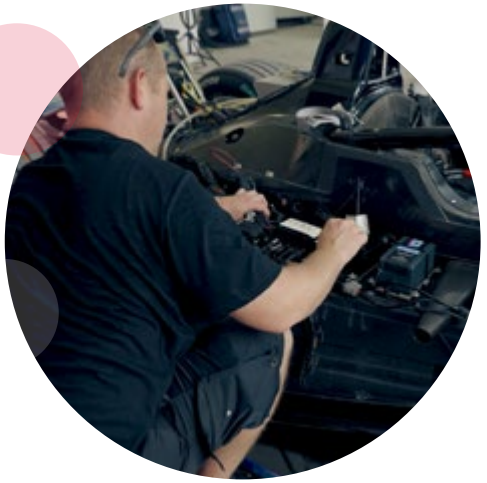
In general, using existing 5G networks would be more cost-effective and environmentally-friendly than installing a dedicated network at each race. “What you lose, though, is the flexibility of being able to control the engineering around those endpoints, and you lose the predictability of exactly what that network environment is going to be if you’re moving from place to place,” cautions Hamish Harris.

To actually become the default connectivity for Formula E, 5G networks will need to be as predictable, consistent and resilient as its dedicated wireless network, he adds. “If you look at the way the technology is evolving, networks are constantly getting better. There’s more throughput on the networks. Maybe it’s not 5G, maybe it’s 6G, but you have to do your testing and work out where you are.”

5G SA: A Platform for Motorsport, Venue Operations and Future Mobility

The connectivity trials being conducted through the CircuitX initiative demonstrate that the future of motorsport will be shaped not simply by faster data transmission, but by the deployment of advanced 5G Standalone (SA) networks that can support multiple mission-critical services simultaneously. While public 5G networks will continue to play an important role, many of the most demanding motorsport applications are likely to require a private 5G SA network, or a hybrid model that combines dedicated private infrastructure with public mobile coverage.

Such an approach provides the performance, reliability, security and operational control required to support mission-critical race operations, while also creating a platform that can serve fans, broadcasters, teams, venue operators and commercial partners from a single connectivity investment.



Beyond Broadcast and Telemetry

Motorsport has traditionally focused on connectivity to support telemetry, timing systems and broadcast delivery. These remain important use cases, particularly as race series seek to provide richer data feeds and more immersive viewing experiences.

For example, 5G SA can enable high-definition live video streams from driver helmets, onboard cameras, pit crews, safety vehicles and race marshals. These capabilities can create entirely new broadcast perspectives while providing race teams and officials with richer operational data. However, the greatest long-term value of advanced cellular connectivity may lie in its ability to improve track safety, security and operational resilience.

A dedicated 5G SA network can provide race control with a reliable, low-latency communications platform capable of distributing safety-critical information simultaneously to multiple vehicles, teams and trackside personnel. During incidents, warnings, hazards or changes to track conditions could be communicated instantly and securely across the circuit. The same infrastructure could support connected safety vehicles, track monitoring systems, incident response teams and emergency services.

By providing a common communications platform, 5G SA can help improve situational awareness for all stakeholders and contribute to safer race operations.



A Strategic Asset for Circuit Owners

From a circuit owner's perspective, a private 5G SA network represents far more than a connectivity upgrade. It is one of the most significant digital infrastructure investments a venue can make and one that can generate value throughout the year.

Rather than installing separate communications systems for race operations, security, broadcast, venue management and fan engagement, a single 5G SA platform can support multiple services through dedicated network slices, each optimised for a specific workload and protected from interference.

Owning the network also allows the circuit to capture operational insights derived from crowd movement, traffic flows, venue utilisation and commercial activity. These insights can support smarter venue management, improve commercial partnerships and help create new revenue opportunities.

Importantly, a circuit equipped with advanced cellular infrastructure can offer connectivity as a service to race series, teams and event organisers. In the same way that circuits provide garages, timing systems and hospitality facilities today, connectivity can become a premium service that is available to every event hosted at the venue.

This creates a compelling commercial model whereby the circuit owner can support major international championships such as Formula E while also democratising access to advanced communications capabilities for smaller race series, independent teams and grassroots motorsport organisations that may not otherwise have access to such technology.

Furthermore, with technologies such as 5G mmWave delivering ultra-high capacity in fan zones, grandstands and hospitality areas, circuits can position themselves as global testbeds for next-generation connectivity, attracting technology partnerships, innovation programmes and industry showcases.

Enabling Consistency for Race Series Owners

For race series owners, connectivity is increasingly becoming a key factor when selecting venues.

A championship's reputation is built on the ability to deliver a consistent experience for teams, broadcasters, partners and fans at every event on the calendar. As data, digital services and fan engagement become more important, connectivity infrastructure is evolving from a supporting utility to a core operational requirement.

A private 5G SA-enabled circuit provides confidence that critical services such as timing systems, race communications, telemetry, broadcasting and digital fan experiences can be delivered reliably regardless of location.

As a result, advanced connectivity infrastructure may increasingly become a differentiator for circuits seeking to attract and retain leading international championships. For many race series, the network will become as important to operational excellence as the track itself.



Delivering Competitive Advantage to Race Teams

For teams, the value proposition is equally compelling.

Race engineers depend on the rapid and secure movement of data between vehicles, garages, analysts and remote operations centres. A private 5G SA network creates an isolated communications environment that protects sensitive vehicle data and team communications from congestion or contention caused by tens of thousands of fan devices using public networks.

The ability to dedicate network resources to specific race operations ensures predictable performance throughout the race weekend, while advanced radio technologies can provide ultra-low latency and high-capacity communications across pit lanes, garages and track infrastructure.

This gives teams access to a secure and reliable digital backbone capable of supporting real-time analysis, collaborative decision-making and future innovations such as remote engineering support and AI-driven race strategy tools.



From Motorsport to Mobility, Entertainment and Defence

The lessons learned through Formula E and CircuitX extend far beyond the racetrack.

The same combination of secure connectivity, network slicing, quality-of-service controls and real-time communications can support immersive entertainment experiences, connected transportation systems and future autonomous vehicles.

At MWC Barcelona 2026, CircuitX partner Elmo demonstrated the remote operation of a vehicle travelling at 157 km/h from a distance of 3,300 km using commercial 5G connectivity and GSMA Open Gateway capabilities. Such examples illustrate how advanced mobile networks can support highly demanding control applications in real-world environments.

The capabilities being validated in motorsport environments may also prove valuable in sectors where reliability, resilience and operational control are paramount, including logistics, public safety and defence. Whether supporting connected vehicles, drones or remote operations, the underlying requirement remains the same: a secure, low-latency network that can deliver predictable performance when it matters most.

For this reason, the future opportunity is not simply about connecting race cars. It is about establishing advanced cellular infrastructure at circuits that can serve as a platform for innovation, enabling a wide range of operational, commercial and societal use cases while creating long-term value for circuit owners, race organisers, teams, partners and fans alike.

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About the GSMA

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

For more information, please visit the GSMA corporate website at gsma.com

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GSMA Foundry is the mobile industry's innovation hub, connecting members, partners and industries to turn ideas into real-world solutions.

Through collaboration, innovation projects and global showcases, GSMA Foundry helps organisations test, validate and scale technologies that solve industry challenges, create business opportunities and accelerate digital transformation.

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The ABB FIA Formula E World Championship is known as the next evolution of motorsport. As the world's first all-electric series, Formula E operates as a living laboratory where innovation, precision science, and visceral adrenaline collide.

We are not the electric version of anything; we are a progressive challenger built to rewrite the rules of elite sport. The Championship, which has achieved the landmark milestone of 150 races, serves as a vital test bed for the world's leading automotive manufacturers, including Porsche, Jaguar, Nissan, Stellantis, Mahindra, and Lola Cars, to innovate and refine the electric vehicle (EV) technologies that accelerate future urban mobility.

Driven by a different energy, Formula E makes progress thrilling by uniting elite spectacle with uncompromising sustainability. As the world's first and only Certified B Corp sport and the first to achieve the BSI Net Zero Pathway certification, Formula E sets the global benchmark for climate action, showing what progress looks like at full speed - not in a lab or boardroom, but on the streets of iconic cities worldwide.

Defined by equal parts rebel and creator, Formula E delivers unpredictable, wheel-to-wheel competition. Across 12 seasons, the series has crowned 10 different champions, proving to be one of the most open and competitive titles in global sport. Built on purposeful ambition, fearless action, and bringing fans closer to the action, Formula E engages a new generation of culture drivers who are excited to shape the future.

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